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THE EFFECT OF VARIOUS TRAINING TECHNIQUES ON THE ACQUISITION OF THE CONCEPT OF CONSERVATION OF SUBSTANCE. FINAL REPORT.

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THE STUDY ASCERTAINED WHETHER VARIOUS TRAINING PROCEDURES CAN INFLUENCE THE ACQUISITION OF THE "PIAGETIAN" CONCEPT OF CONSERVATION OF SUBSTANCE. EQUAL NUMBERS OF MALE AND FEMALE, CAUCASIAN, KINDERGARTEN CHILDREN WERE RANDOMLY ASSIGNED TO FOUR EXPERIMENTAL AND TWO CONTROL GROUPS. THE TRAINING CONDITIONS WERE COGNITIVE CONFLICT, LANGUAGE ACTIVATION, MULTIPLE CLASSIFICATION, AND VERBAL ROLE INSTRUCTION. INDIVIDUAL TRAINING GROUP TREATMENTS WERE SIMILAR TO THE WORK OF (1) SMEDSLUND WITH COGNITIVE CONFLICT, (2) BRUNER WITH LANGUAGE ACTIVATION, (3) SIGEL WITH MULTIPLE CLASSIFICATION, AND (4) BEILEN WITH VERBAL ROLE INSTRUCTION. A POST-TEST-ONLY DESIGN WAS USED. EACH SUBJECT WAS INDIVIDUALLY TESTED ON TWO NON-VERBAL TASKS IN WHICH THE LAW OF CONSERVATION OF SUBSTANCE WAS VIOLATED, AND ONE PIAGETIAN TEST OF CONSERVATION OF SUBSTANCE. THE SUBJECTS IN ALL GROUPS WERE TESTED ONE WEEK, TWO MONTHS, AND SIX MONTHS AFTER THE LAST TRAINING SESSION. THE CONCLUSIONS WERE (1) THAT THE "PIAGETIAN" CONCEPT OF CONSERVATION OF SUBSTANCE WAS NOT INDUCED BY THE TRAINING TECHNIQUES EMPLOYED, (2) THAT LANGUAGE INTERFERES WITH ACQUISITION OF THE CONCEPT OF CONSERVATION OF SUBSTANCE, AND (3) THE PROBLEM OF REVERSALS MERITS FURTHER EXPLORATION. (DS)

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February 1967

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Problem

Increased emphasis on revision of the mathematics curriculum and the introduction of modern mathematics as early as kindergarten has led to the controversy over the most appropriate time to teach the concept of number. As a result, a renewed interest in Piaget's experiments on the child's conception of number has become evident.

According to Piaget, the concept of number[1] is predicated on the concept of conservation of substance. The attainment of the concept of conservation of substance enables the child to recognize that the "amount" or "number" remains the same in spite of spatial rearrangements. The following paragraphs describe an example of Piaget's tasks requiring verbal conservation of continuous quantity. A child is confronted with two identical containers of liquid. After the child is convinced that the amount of liquid in both is the same, the contents from one of the containers is poured into three other containers. The child is then questioned as to the equality of the amount of liquid in the three containers and the original container. A child is said to have attained the concept of conservation of substance when he recognizes that the amounts are the same and he is able to explain why. On the other hand, if the child responds that the amounts are different, then he is said not to have attained the concept of conservation of substance.

Piaget maintains that specific training or teaching play little or no role in the acquisition of this concept. He suggests that the child attains the concept of conservation of substance by interaction with his "total" environment. In contrast, Bruner (1964), Sigel (1965), Beilen (1966), and Smedslund (1961a) suggest that one can teach or induce the concept of conservation of substance in the child.

Because there are theoretical reasons for believing that the concept of conservation of substance is relevant to a child's number development, the question arises whether or not children can be taught the concept of conservation of substance.

Theory

In looking at Piaget's theory on development in general, it is possible to see the position of the concept of conservation within the total scheme. Piaget's developmental view stresses the process of adaptation as the crucial ingredient of all development. By this process, the child moves through four major stages of

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[1]Number here refers to the coordination of classification and seriation.

development: sensorimotor, pre-operational, concrete operational, and formal operational. At each stage, the intellectual structures are qualitatively, as well as quantitatively, different from each other. Modification of intellectual structures suggests a change in both quality and quantity of intellectual structures commonly called acceleration. According to Piaget, this modification or acceleration involves all of the child's activity.

Piaget's analysis of "all children's activity" leads him to postulate two kinds of experience: physical experience, and logical mathematical experience. Physical experience refers to the child's empirical judgements about objects in his environment. For example, he discovers that a book weighs more than a pencil. On the other hand, logical mathematical experience refers to knowledge not drawn from the objects, but knowledge drawn by the actions affected upon the objects. For example, a child's awareness that six beads, despite rearrangement, and hence perceptual distortions, are still six beads. It is this property of ordering, and other similar properties, which embrace "all" of the child's activity or experience. These properties are acquired over a fairly long period of time, and consequently, according to Piaget, acquisition of such properties tends to minimize the effects of brief training sessions, and in turn suggests a much wider, longer lasting fundamental approach to modification of intellectual structures.

Furthermore, on logical grounds, the argument that training on a few specific tasks would induce conservation is as specious as the argument that specific training on a limited number of tasks from I. Q. tests would improve intelligence. Increased performance on these I. Q. tests as a consequence of training does not necessarily imply increased intelligence. So too, specific training on conservation tasks does not guarantee the acquisition of the concept of conservation.

Although Piagetian theory and specific training are incompatible, some of the literature reported below, however, suggests that intellectual structures can be modified over a relatively short period of time. The problem of this study, then, is to provide more evidence on the question of whether or not mental stuctures can be modified over a relatively short period of time.

Related Literature

The literature appears equivocal as to the feasibility of inducing the concept of conservation. Consistent with Piagetian theory, Wohlwill (1960) has been unsuccessful in inducing conservation of number. Similarly, Beilen, and Franklin (1962) have been unsuccessful in inducing conservation of area. Prager (1966), using her own class was also unable to induce conservation of substance.

These studies seem to suggest that regardless of the kind of conservation that one tries to induce, that in general such

training is not successful.

In testing for the presence of conservation, rather than attempting to induce it, Mermelstein (1967) found no difference in performance on conservation of substance tasks between those children who had formal schooling and those who did not in Prince Edward County, Virginia. Similarly, Goodenough's (1966) study in Hong Kong and Price-William's (1961) study with African bush children indicate no difference in performance on conservation of substance tasks between children who had and those who didn't have formal schooling.

These studies suggest that "specific" training such as formal schooling does not necessarily modify intellectual structures. These kinds of formal short term training lead to what Flavell (1963) aptly calls the hollow core of conservation or pseudo-conservation.

On the other hand, although Smedslund reports negative results in attempting to induce conservation of weight, in another study (1961c) in which he introduces the idea of cognitive conflict Smedslund appears to have had some success in inducing the concept of conservation of substance. Similarly, Gruen (1965), employing a cognitive conflict technique, induced the concept of conservation of substance. Bruner (1964) also reports success in inducing the concept of conservation of substance but by a language activation technique rather than a cognitive conflict technique. Utilizing a somewhat similar technique to cognitive conflict, Wallach and Sprott (1964) induced number conservation by reversibility training. Employing still another technique, verbal rule instruction, Beilen (1966) reports some success in inducing conservation of length. And finally, Roeper and Sigel (1966) employing a technique which incorporates aspects of the techniques described above, reports success in inducing the concept of conservation of substance. In particular Roeper and Sigel (1966) maintain that training in multiple labeling, in multiple classification, in multiple relations, in reversibility will facilitate acquisition of the concept of conservation of substance. These investigators, in contrast to investigators mentioned in the preceding section, suggest the possibility of inducing various kinds of conservation by a variety of training techniques. Because of the equivocal results reported, an analysis of the various training techniques seems appropriate.

If specific training does make a difference, the present investigators feel that Smedslund's cognitive conflict theory provides the greatest promise for success because of its similarity to Piaget's theory of adaptation. Piaget's discussion on strategies to decrease egocentric thought in the child provides a good illustration of the similarity of the cognitive conflict position and the adaptation position. Egocentric thought, the inability to adopt another person's view, permeates children's thinking during the pre-operational stage. In order to reduce the egocentrism in the child, Piaget suggests socialization with other children in the form of play. In essence, Piaget suggests the confrontation of different viewpoints. As a result, the child's

intellectual structures become modified and he is able to take another's point of view.

The conflicting viewpoints which come about in child play reflect a great similarity between Smedslund's cognitive conflict position and Piaget's adaptation position. Moreover, Piaget's recipe for decreasing egocentrism in no way contradicts his anti-training position. Piaget suggests that play covers a wide range of experiences which coincides with his notion of "all the child's activities". Thus, these are similar concepts to account for the change in intellectual structures.

Furthermore, both adaptation and cogntive conflict processes employ the disequilibrium-equilibrium model. In both instances, the child moves toward a state of temporary equilibrium from a state of disequilibrium. Similarities in the two processes would suggest that training procedures based on a cognitive conflict position may be in part successful.

The cognitive conflict theory can be translated into practice in various ways. One illustration of cognitive conflict training procedure involves first presenting the child with cups and saucers in a perfect one to one correspondence over a number of trials each day for two weeks or more. After this period, the child is presented with the same number of cups and saucers, but not in one to one correspondence. This procedure provides for perceptual cues leading to a different judgement among non-conservers. Consequently, these procedures will give rise to competing responses inducing a state of cognitive conflict: This state of disequilibrium would result in a tendency toward equilibrium and a modification of the intellectual structure which, in turn, insures conservation of substance.

In contrast to the cognitive conflict argument, Sigel, Beilen and Bruner present arguments for the possibility of inducing conservation which are either inconsistent or partially consistent with Piagetian theory. Because of their inconsistency with Piagetian theory, which will be described shortly, an attempt will be made to demonstrate that the training techniques are not inducing the "Piagetian" concept of conservation of substance but rather these training techniques are creating a pseudo-conservation. A brief description of Sigel's, Bruner's and Beilen's theories and their training procedures follows.

Sigel's argument is predicated on the assumption that one must base the learning of complex structures on simpler structures. He claims that acquisition of conservation of substance follows the acquisition of simpler structures such as multiple labeling, multiple classification, multiple relations and reversibility. More specifically, he maintains that training in multiple labeling, multiple classification, multiple relations and reversibility, in that order, should facilitate the acquisition of conservation.

Sigel's training procedure involves having the child introduced to objects such as a piece of fruit and encouraging the child to label it. This procedure is repeated with another object, such as a piece of fruit, an orange. After having focused on the characteristics of each, the child is asked about two similar objects, a tangerine and an orange. The differences are noted by the child and then he is questioned as to their similarities. After the child has ascertained apparent similarities such as shape and color, another basis of classification is introduced. The process goes on again naming the attributes and the defining criteria for a class. Attention is then directed to the superordinate class, fruit, to which both belong. Following this, the children are introduced to the idea of multiplicative relations. For example, the child is asked, "Can you think of two things that you are at the same time?" Finally, reversibility is discussed, using numbers. For example, dividing a set of pennies into smaller subsets and having the children discuss why the number of pennies are either the same or not the same.

Thus, according to Sigel, giving the child an awareness that objects have multiple characteristics, that these can be combined in various ways to produce new categories and that categories of objects can be reorganized and brought back to the original, that is reversibility, provides him with the necessary prerequisites for conservation.

Although Sigel procedures indeed are necessary conditions for conservation of substance, they are not, however, sufficient conditions. Sigel's training assumes, that once the prerequisites for conservation have been met, the concept of conservation necessarily has been attained. Sigel assumes further that because the material is presented in a prescribed manner, the child will assimilate the material in the corresponding order. Such a claim is not consistent with Piagetian theory. For if the child constructs his reality, it does not necessarily follow that he will assimilate the material in the manner presented.

Whereas Sigel's training originated in part from Piagetian theory, Beilen's training procedure appears to violate Piagetian theory directly.

Beilen training procedure, verbal rule instruction, provides the child with a statement of the rule to be applied to the problem in each instance of an unsuccessful trial response on a conservation task. The experimenter judges whether the child gave an adequate conservation explanation. On any trial where the child responded incorrectly and/or gave an inadequate explanation, the principle of conservation of number is explained as follows: "Now I am moving them. See, they are standing in a different place. But there are just as many chips as before. They only look different. See, I can put them back just as they were before, so you see, there are still the same number as before because I did not add any chips or take away any chips. I only moved them."

The use of a rule in a training technique appears inconsistent with Piagetian theory. To begin with, the egocentric nature of the child's thought seriously hampers his ability to adopt another point of view. Secondly, the syncretic nature of the child's mental structure with its behavioral manifestations of juxtaposition prevents him from accurately perceiving the rule. Further, Mermelstein and Shulman's research (1967) indicated that children under 9 years of age perceive only the gist of questions or the events of the questions. It follows from this that two sentences which stress "amount", for example, but in very different ways, will be perceived as similar by the child. This casts doubt on the child's ability to understand a "specific" rule.

Similarly, Bruner's contentions on language training also appear to be inconsistent with Piagetian theory.

Bruner's language activation training involves presenting two identical beakers partially filled with equal amounts of water. The child acknowledges that they have the same amount of water. A wider beaker of the same height as the identical beakers is placed with them behind a screen so that they are hidden from the child except for their tops. The experimenter pours the water from one of the two identical beakers into the wider beaker. Without seeing the water level, which is hidden by the screen, the child is asked which of the two remaining beakers has more, or do they both have the same. With the screen present, the child usually says they are the same. Now the screen is removed, and the child is again asked which has more or if they have the same. Although perceptually the two beakers of water are different, Bruner suggests that the language activated, first in the presentation of the identical beakers where the child judges them to contain the same amount of water, and again when the beakers are behind the screen and the child judges the wider one to contain the same amount as the narrower one, will decrease the reliance on perceptual cues and the child will similarly maintain that the amounts are the same.

Bruner's training position is predicated on the assumption that focusing on the linguistic aspect of a situation will decrease the strength of the perceptual cues, resulting in a mental structure which is a function of the language activated. This differs markedly from Piagetian theory in that Piaget believes that the mental structure precedes language development.

To recapitulate then because the concept of conservation derives from Piagetian theory and further because the rationale for the Sigel, the Beilen and the Bruner training are judged to be inconsistent with Piagetian theory it was hypothesized that these training procedures would not be effective. On the other hand because of the greater congruence of Smedslund's position to Piagetian theory it was hypothesized that such training would be more successful than the other three training procedures.

Objectives

Accordingly then, the objectives of this study were to ascertain whether various training procedures can influence the acquisition of the concept of conservation of substance. In view of these pbjectives, the following hypotheses were forwarded:

1. A significant difference exists in the performance in conservation tasks between children who had cognitive conflict training and those who had no training.

2. No significant difference exists in the performance on conservation tasks between children who had multiple classification training and those who had no training.

3. No significant difference exists in the performance on conservation tasks between children who had verbal rule training and those who had no training.

4. No significant difference exists in the performance on conservation tasks between children who had language activation training and those who had no training.

Method

Subjects:

In order to assess the effects of various training procedures on the attainment of the concept of conservation of substance, a sample of kindergarten children from the Long Island area were selected for this study. Five year olds were chosen because the writings of Piaget indicate that children of this age generally have not attained the concept of conservation of substance. These primary school children were operationally defined as between 5.0 and 6.2 years of age. In addition to control conditions the subjects were randomly assigned to four training conditions; cognitive conflict, language activation, multiple classification and verbal rule instruction. This random assignment was made with two restrictions. First, equal numbers of males and females were assigned to each condition. Second, non-white children were excluded from the population. The purpose of these restrictions was to control for the possible sex and ethnic effects. Twenty subjects were drawn for each of the four training groups and for the two control groups.

Training Apparatus:

Red, white and blue poker chips were used in all four training conditions in order to minimize task variability. A wooden box 16 3/4" long x 6 ½" wide x 6 ¼" deep was employed in the pretest, cognitive conflict training, multiple classification train-

ing, and verbal rule instruction training. The top of the box was divided lengthwise with one side remaining stationary and the other side broken crosswise and hinged together at its center. A rod was attached to the hinge through an opening in the side of the box. The rod could be moved downward through a slit in the side of the box, enabling the center portion of the broken side to collapse to the center of the box. This box lent itself to perceptual distortion of a one-to-one correspondence numerical arrangement.

In the fourth training condition, language activation, three square wooden boxes, each with two transparent parallel sides, were employed. Two of the wooden boxes were identical in size, 4½ x4½ x 6", while the third box was the same height (6"), but wider (7" x 7").

The apparatus for all the training techniques conformed in principle to the requirements of each training procedure. *

Post-test Apparatus:

Three tasks for conservation of continuous and discontinuous substance were used to assess the effects of training upon the development of conservation. These tasks were presented one week, two months and six months after the training.

Two 150 m.l. beakers, two 1000 m.l. jars, a screen and attached stand, a clamp and a two foot rubber tube which connects one of the 1000 m.l. jars through an opening in the screen to the 1000 m.l. jar which the subject sees, were used to test for the conservation of continuous substance.

26 gumballs, two wooden boxes, superficially identical, 4¼ x 4¼ x 7", one of which has a false bottom, 2" deep, in which additional gumballs may be concealed, and two containers into which the gumballs may be poured, were used to test for conservation of discontinuous substance.

The third task, also for conservation of discontinuous substance, is a typical Piagetian task. The equipment consisted of two 150 m.l. beakers, 16 gumballs, a 50 m.l. graduated cylinder, and a 600 m.l. beaker.

*Although the present study may not be regarded as an explicit replication of either the Smedslund, Bruner, Sigel, or Beilem training technique, it is felt to be a fair test of the principles which underlie these techniques. In other words while there were some slight variations in procedure to make the experimental tasks comparable, the basic assumptions stated by these investigators were not violated.

Procedure

I. Description of the Pre-Test and Scoring of Responses:

In order to ascertain the effects of pre-testing, one control group was given a pre-test whereas the other cpntrol group and the four training groups were not. The possibility of the pre-test serving as an additional training session or differentially affecting the various training techniques necessitated its elimination from the training conditions.

The pre-test task employed the collapsible box and 20 poker chips. As the experimenter set up 10 chips down one side of the top of the box, the subject simultaneously set up 10 chips in one-to-one correspondence with those of the experimenter. After the experimenter verbally established that he and the child had equal numbers of chips, one row of chips was collapsed by the experimenter, and hence, perceptually distorted. The subject was then asked whether the chips on the collapsed side were still the same amount as those on the stationary side. If the subject's response was positive and his explanation indicated understanding, that is, he realized the chips merely changed position, he was scored as a conserver. A subject who answered affirmatively without an adequate explanation, or a subject who answered negatively, was scored as a non-conserver.

II. Description of the Training Procedures:

The four training conditions, cognitive conflict (Smedslund), multiple classification (Sigel), verbal rule instruction (Beilen), and language activation (Bruner), each began with free play and were followed by eight training sessions, two times a week for approximately ten minutes. The first training session was devoted entirely to introducing the subjects to the red, white and blue poker chips and allowing them to manipulate them in any way they chose. In each of the successive eight training sessions for the first two minutes the subjects were permitted to play with the chips. The remainder of each session was devoted to formal training.

Cognitive Conflict - Smedslund:

The cognitive conflict training involved the collapsible box and twenty poker chips. Following the free play, where the subjects were allowed to manipulate the chips, the group of subjects received ten chips of one color and the experimenter received ten chips of the same color. In the first session, red chips were employed, in the second session blue, and in the third white, with this color order being maintained throughout the remaining sessions. As the experimenter placed a chip on one side of the top of the box, the subjects simultaneously placed another chip next to it until all twenty chips were in one-to-one correspondence. Following the placement of each pair of chips, the experimenter asked the subjects questions such as "Are there the same

amount of chips on both sides of the box? Do the children have the same amount as the teacher? How do you know? If the subjects did not realize the equality of the two rows of chips, they were encouraged to count the chips. After five sessions of setting up the chips in one-to-one correspondence, the task was altered. In the next three sessions, after the chips were similarly set up in one-to-one correspondence and the sameness of the two rows of chips was established, the experimenter moved the switch hinged on the side of the box and one of the rows of chips fell to the center of the collapsed side. The subjects were asked, "Are there still the same amount of chips on both sides?"

Multiple Classification - Sigel:

The multiple classification training also involved twenty poker chips and a collapsible box. Free play with the chips preceded the formal training. The training was divided into four phases:

1. multiple labeling
2. multiple classification
3. multiple relations
4. reversibility

For the first four training sessions, one training session was devoted to each phase while each of the remaining four training sessions encompassed all four phases.

In multiple labeling training the experimenter initiated discussion which elicited the naming of the poker chips in a variety of ways; i.e., a poker chip can also be a checker or toy money. This "naming" was clarified for the subjects by the experimenter suggesting that a person could have many names; i.e., mother, teacher, woman, wife, etc..

In the multiple classification training, the experimenter initiated discussion which elicited from the subjects the common properties of the chips; i.e., all the chips have color, shape, purpose, texture and size.

In the multiple relations training, the experimenter initiated discussion which led the subjects to understand that a chip can be two things at the same time. That is, a chip can have a color and shape at the same time. The question that was posed is, "Can you think of two things this poker chip can be at the same time?" Since a different colored poker chip was used at each session, three relationships were established: (1) round and red, (2) round and blue, and (3) round and white.

In the reversibility training the collapsible box and twenty chips were employed. The experimenter and the subjects set up the chips in one-to-one corresponsence so that the subjects could see the sameness of the two rows of chips. After the subjects responded positively to the question, "Are there the same amount

of chips on both sides?", the experimenter collapsed one side of the box. Again the subjects were asked whether there were the same amount of chips on both sides of the box and why. An informal explanation to establish the equivalence of both sides was then provided by the experimenter.

It should be pointed out that although superficial similarities exist between Smedslund's cognitive conflict training and the reversibility training of Sigel, they differ in that in the Sigel reversibility training the equality of the rows of chips and the subsequent collapse of one row was accomplished in one training session whereas Smedslund's training procedure had four training sessions on the equality of chips prior to collapse of one row of chips. In addition the Sigel technique provided explanations for the equivalence of both rows after the deformation, whereas the Smedslund technique did not.

Verbal Rule Instruction - Beilen:

The verbal rule instruction, as well as multiple classification, employed the collapsible box and twenty chips. Following the free play the group of subjects and the experimenter each received five chips of one color. As in the cognitive conflict training, the chips were set up in one-to-one correspondence and their equivalence was established. But in contrast to the cognitive conflict training, the experimenter immediately collapsed one side of the box and asked whether there are the same amount of chips on both sides. Regardless of the positive or negative responses of the subjects, the experimenter said the following rule while manipulating the box accordingly: "Now I am moving them. See, they are standing in a different place, but there are as many chips as before. They only look different. See, I can put them back just the way they were, so you see, there are still the same number as before because I did not add any chips or take away any chips. I only moved them." In the next session, twenty chips of the same color used in the preceding session were used, and in subsequent sessions, for each color, first ten and then twenty chips were used.

Language Activation - Bruner:

The language activation training involved three wooden boxes, each with two transparent parallel sides, two of which were identical, while the third is the same height but wider than the others, a screen, and twenty chips. Following the free play, using a one-to-one correspondence technique, the subjects filled one box with ten poker chips while the experimenter simultaneously filled the other identical box. The third box was placed with the two filled boxes behind the screen so that only their tops could be seen. The experimenter poured the chips from one of the filled boxes into the third unfilled, wider box. The child was asked whether there were the same amount of chips in the newly filled box as in the remaining previously filled box. It was expected

that the subject would say that there were the same. The screen was removed and the subject was again asked whether the boxes held the same amount. Since one box was wider, the chips in it were spread out, and were therefore perceptually different from those in the narrower box. This training procedure was repeated for each of the three color chips in subsequent sessions.

III. Description of the Post-Tests and Scoring of Responses:

In order to test the effects of various training treatments, two non-verbal tasks in which the law of conservation of substance was violated, and one Piagetian test of conservation of substance were employed. Conservation of substance tasks were utilized not only because the previous investigators suggested that this concept could be induced utilizing their approach, but also because of the availability of two non-verbal surprise conservation of substance tests. Accordingly the three conservation tasks tested whether the child could tranfer any specific learning to a more general situation.

Each subject was tested individually. The sequence in which the tasks were presented were counter-balanced to control for order effects. The criteria for the attainmnet of the concept on conservation of substance were stage three responses on any two of the three post-tests.

A relaxing of the criteria to ascertain the effectiveness of training to successfully passing two tasks rather than all three tasks was predicated on the argument that since most of the forementioned hypotheses predicted no difference as a consequence of training, maximum opportunity should be afforded to demonstrate a difference if one exists.

The two non-verbal experiments differed from the pre-test and training conditions in two ways: (1) the non-verbal experiments made use of the violation of the law of conservation of substance, whereas the pre-test and training conditions made use of the law of conservation of substance, (2) they did not depend on the language facility of the subject, whereas the pre-test and training conditions did.

Moreover utilizing tasks in which the violation of the concept of conservation of substance was demonstrated in conjunction with a standard Piagetian conservation of substance task moves toward the Piagetian criterion for generalizability with respect to concept acquisition.

Tasks

1. Non-Verbal Continuous Task:

The first non-verbal experiment, the magic experiment for conservation of a continuous substance, consisted of first allow-

ing each child to satisfy himself that two 150 m.l. beakers contained the same quantity of liquid. The contents of one of the beakers was then poured into a 1000 m.l. jar which it apparently filled. The child's gestures and reactions were noted. Gestures of surprise, puzzlement, smile, "wow" were scored at stage three, presence of conservation, whereas absence of observable changes in behavior were scored at stage one, absence of conservation. The illusion was created by surreptitiously opening a valve connecting the empty 1000 m.l. jar to one which was full and hidden behind the screen. The experimenter controlled the rate at which the visible jar filled.

2. Non-verbal Discrete Task:

The second non-verbal magic experiment, for a discontinuous substance, again violated the law on conservation; it assumed that a child who had attained the concept would recognize the violation. Two seemingly identical wooden boxes, one with a false bottom, and 26 gumballs were employed. Each child was told to put eight gumballs into the wooden box with the false bottom, one by one, as the experimenter put eight gumballs into the second wooden box. Under the false bottom in the child's box was an additional 10 gumballs. The child and the experimenter both poured the contents of their wooden boxes into two separate containers. When the contents of the child's box were poured, a latch released the additional ten gumballs. The child's reactions and comments to the gumballs in the containers were noted. Scoring of these responses was similar to those for the first post-test for continuous substance.

3. Verbal Piagetian Task:

The third task was a typical Piagetian verbal test for conservation of discrete substance. Each child was told to put eight gumballs into a 150 m.l. beaker, one by one, at the same time the experimenter put gumballs into another 150 m.l. beaker. The contents of one beaker were then poured into a 50 m.l. graduated cylinder, while the contents of the second beaker were poured into a 600 m.l. beaker. The child was then asked whether the quantities in each were the same.

IV. Testing of Subjects:

The subjects in the four training conditions and the two control conditions were tested one week, two months and six months after the last training session. Testing the subjects over this period of time satisfied the second and final Piagetian criterion for ascertaining whether the concept of conservation was induced.

Results

Attempts to test hypotheses of "no difference" are replete with logical and statistical hazards. There are some who maintain that to demonstrate such a state is impossible. Others simply consider it extremely difficult. In presenting these results, it shall be understood that when the confirmation of a hypotheses of "no difference" is suggested, it is to be interpreted in the following way: The hypothesis that a large difference is demonstrable in this given situation is significantly improbable. Though this is awkward language, it remains appropriate to the objectives of this research and to the demands of statistical theory. When the research hypothesis is, in fact, one of equality, it would seem quite inaccurate, to couch it in terms of an inequality only for purposes of statistical expediency.

In testing hypotheses of no difference, we are primarily concerned with minimizing the likelihood of accepting this hypothesis when in fact there is a difference. In other words, we wish to minimize the probability of committing a Type II error. One way to minimize this probability is by fixing the alpha level of significance for hypothesis of no difference at .10. Fixing the level of significance at .10 rather than the normal level of .05 for a fixed N and for a fixed alternative reduces the probability of committing a Type II error. If for this fixed alpha level of .10, we still have no reason to reject the hypothesis of no difference, the likelifood of rejecting a false hypothesis is improved. When testing hypotheses which predict differences however, we return to the more commonly utilized .05 level of significance.

In most cases, since our data were clearly categorical, the Chi-square statistic was utilized. The percent of agreement between three judges on categorizing the responses on the three tasks was 90%. The average number of training sessions was 7 for all training conditions.

Table 1 shows the results of the performance of the subjects under six conditions on post-tests one week, two months, and six months after training respectively.

A 2 x 6 Chi-square for each post-test session indicated that children who had training did not out perform children who did not have training; and further that the pre-tested control group did not out perform the non-pretested control group. Accordingly, the cognitive conflict hypothesis was rejected whereas the other three hypotheses were confirmed.

Table 2 represents yet a more detailed description of the results for children who attained stage III responses on the three conservation tasks for the three testing sessions. It appears that on all three testing sessions non-verbal discrete tasks were easier than the verbal tasks and the non-verbal continuous task.

Table 1

The Number of Subjects Under the Six Conditions on the Post-Tests, one week, two months and six months after training respectively

First Administered Post-Test - one week after training

	Control I	Control II	Beilen	Smedslund	Sigel	Bruner	Total
Stage I	16	13	12	14	18	13	86
Stage III	4	7	6	6	1	6	30
Total	n=20	n=20	n=18	n=20	n=19	n=19	n=116

x^2 : x^2 = 6.48 with 5 d.f., (p. > .10) not significant

Second Administered Post- Test - Two months after training

Stage I	16	11	11	13	15	9	76
Stage III Stage III	4	9	8	6	3	9	38
Total	n=20	n=20	n=19	n= 19	n=18	n=18	n=114

x^2 : x^2 =6.3 with 5 d.f., p. > .10 not significant

Third Administered Post-Test - six months after training

Stage I	15	9	10	7	6	9	56
Stage III	3	7	6	8	5	7	36
Total	n=18	n=16	n=16	n=15	n=11	n=16	n=92

x2 : x2 = 3.91 with 5 d.f., p. > .10 not significant

Table 2

Number of Children Who Attained Stage III Responses at Three Post-Test Periods.

Post-Tests / Tasks	Testing Period: 1st Administered Post-Test 2 weeks	2nd Administered Post-Test 2 months	3rd Administered Post-Test 6 months
Verbal Discrete	19	16	23
Non-Verbal Discrete	30	38	32
Non-Verbal Continuous	15	32	30

Table 2 does not indicate whether the same children who were conservers (attained stage III) on the first post-test were also conservers on the second or third post-test. The question arose whether any children, who were conservers on the first post-test, were not conservers on the second or third post-test. In other words, were there any reversals?

Table 3 indicates the number of subjects who made reversals from the first post-test to the second and third post-test on the three tasks. The relevant reversals are: passing the task on the first post-test and failing the task on the second post-test (PF), (these were for subjects who were post-tested twice only), passing the task on the first post-test and second post-test and failing the task on the third post-test, (PPF), passing the task on the first post-test and failing the task on the second and third post-tests (PFF), failing the task on the first post-test, passing the task on the second post-test and failing the task on the third post-test (FPF), and passing the task on the first post-test, failing the task on the second post-test and passing the task on the third post-test (PFP). Passing an item meant a stage III response whereas failing an item meant a stage I response.

Table 3

Number of Subjects Who Made Reversals on the Three Post-Tests for Each of the Three Tasks

Tasks	PF	PPF	PFF	FPF	PFP
Verbal Discrete	1	3	7	4	3
Non-verbal Discrete	3	6	1	3	1
Non-Verbal Continuous	2	1	3	5	0

Inspection of table 3 reveals several reversals from one post-test to another. These results coupled with the changes in responses from one post-test to another shown in Table 6, suggest that the reliability of the indivdual measures may be open to question or that the trait iself may not be stable. Instead of individual task measures a more reliable measure, an average score of the subject's responses on the three tasks over the three post-tests was obtained. The average score was obtained by assigning each response a ranking from 1 to 3 and then obtaining an arithmetic average. In particular, stage III responses were given a score of 3, stage II responses, a score of 2 and stage I responses, a score of 1. If for example a subject had all stage I responses on the first post-test, had all stage II responses on the second post-test, and had all stage III responses on the third post-test, then his average score would be 2 or 18/9. Table 4 describes this average score of the subject's responses on the three tasks over the three post-tests.

Table 4

Average Score of All the Subject's Responses on the Three Tasks Over the Three Post-Tests for Each of the Six Conditions

Control I	Control II	Bruner	Beilen	Sigel	Smedslund
2.4	2.8	2.6	2.0	2.1	2.4
2.1	2.1	1.8	2.7	1.8	2.6
3.0	2.6	2.3	2.7	1.8	1.7
2.7	2.4	2.6	2.0	1.4	2.8
1.5	2.7	2.8	2.6	2.0	2.1
1.4	2.1	2.3	2.0	1.4	2.4
1.6	2.6	2.2	1.0	2.3	1.8
1.0	1.3	1.1	1.7	1.7	1.0
1.0	1.0	1.1	2.2	1.0	1.8
1.0	1.2	1.2	2.1	1.2	1.3
1.0	1.0	1.0	2.4	1.9	1.2
1.0	1.5	1.8	1.0	1.4	1.1
1.2	1.7	2.2	1.0	1.1	1.8
1.7	1.4	1.6	1.7	1.1	1.0
1.2	2.0	2.3	1.9	1.0	1.2
1.4	2.0	2.3	1.6	1.2	2.1
1.4	1.3	2.1	1.4	1.0	1.1
1.7	1.4	1.1	1.0	2.4	1.6
1.7	1.8	1.2		1.2	1.8
2.0					1.7

Such a score as depicted in Table 4 represents an improved criterion for testing the hypotheses. Accordingly such an improved criterion leads to a more powerful test of the forementioned hypotheses than the Chi-square test. Because the assumptions

of one-way analysis of variants were not met, a non-parametric technique, The Kruskal-Wallis one way analysis of variance by ranks was used to test the hypotheses. Such a non-parametric technique has an asymptotic efficiency of 95%.

Inspection of Table 5 indicates that there are no significant differences between the six treatment conditions. This analysis supports the results of the Chi-square analysis described in Table 1.

Table 5

Kruskal-Wallis one-way analysis of variants by ranks:
Rank of scores under 6 treatment conditions

Control I	Control II	Bruner	Beilen	Sigel	Smedslund
9	9	9	9	9	9
9	9	21	9	9	9
9	29.5	21	9	9	21
9	36	21	9	21	21
9	36	29.5	42	21	29.5
29.5	42	29.5	50.5	29.5	29.5
29.5	42	50.5	57	29.5	36
42	47.5	62	57	29.5	50.5
42	57	62	71.5	42	57
42	62	83.5	76	42	57
47.5	76	89	76	42	62
50.5	76	89	76	57	62
57	83.5	93	83.5	62	62
57	83.5	93	89	62	62
57	98.5	93	98.5	71.5	83.5
76	104.5	93	104.5	76	83.5
83.5	104.5	104.5	109.5	83.5	98.5
98.5	109.5	104.5	109.5	93	98.5
109.5	113	113		98.5	104.5
115					113

R_1=981.5 R_2=1219.0 R_3=1761.0 R_4=1136.5 R_5=887.0 R_6=1149.0

H=4 with d.f. = 5
P<.20 not significant at .10 level

Table 6 presents the distribution of all subjects into three stages of development on the six conditions for the three tasks for each of the three post-tests. The tasks are described in terms of the non-verbal or verbal dimension and the continuous dimension. Inspection of data indicates that the non-verbal discrete task had

the greatest number of stage III responses on all the training conditions and the two control conditions over the three testing sessions. This suggests that success on the non-verbal discrete tasks is independent of the particular treatment administered. A comparison of the non-verbal continuous task and the verbal discrete task reveals that on all the control conditions for the three post-tests the non-verbal continuous task had more or at least equal number of stage III responses than the verbal discrete tasks. But for each of the training conditions on the first post-test, it is interesting to note that more stage III responses are recorded for the verbal discrete task than the non-verbal continuous task. However, this distribution is reversed for the second post-test. On the third post-test however there is a tendency to an equality of stage III responses for both tasks. These results indicate variability of response among these two tasks as well as variability of response for each task over time.

Further inspection of Table 6 indicates stage II responses for the verbal discrete task on all post-tests but no stage II responses for either of the two non-verbal surprise tasks on any of the post-tests. This is in part a function of the measuring instrument. It is difficult to distinguish an intermediary stage for surprise.

Table 6

Distribution of All Subjects into Three Stages of Development on Six Conditions for the Three tasks for Each of the Three Post-Tests

Post-Test I

		Pre-tested Control #1	#2	Bruner	Beilen	Sigel	Smedslund
Verbal Discrete	Stage 1	13	13	5	9	11	10
	Stage 2	3	2	6	4	5	5
	Stage 3	4	5	8	5	3	5
Non-Verbal Discrete	Stage 1	12	10	9	12	16	11
	Stage 2	0	0	0	0	0	0
	Stage 3	8	10	10	6	3	9
Non-Verbal Continuous	Stage 1	12	15	17	15	17	17
	Stage 2	0	0	0	0	0	0
	Stage 3	8	5	2	3	2	3

(continued)

Table 6 (continued)

Post-test II

		Pre-tested Control	#1	#2	Bruner	Beilen	Sigel	Smedslund
Verbal Discrete	Stage 1	12	9	3	10	10	7	
	Stage 2	5	5	10	2	7	11	
	Stage 3	3	6	5	7	1	1	
Non-Verbal Discrete	Stage 1	13	8	8	10	9	12	
	Stage 2	0	0	0	0	0	0	
	Stage 3	7	12	10	9	9	7	
Non-Verbal Continuous	Stage 1	14	10	13	10	14	13	
	Stage 2	0	0	0	0	0	0	
	Stage 3	6	10	5	9	4	6	

Post-test III

Verbal Discrete	Stage 1	13	9	8	8	4	9
	Stage 2	2	1	2	1	3	1
	Stage 3	3	6	6	7	4	5
Non-Verbal Discrete	Stage 1	13	10	9	7	6	8
	Stage 2	0	0	0	0	0	0
	Stage 3	5	6	7	9	5	7
Non-Verbal Continuous	Stage 1	13	8	11	9	8	9
	Stage 2	0	0	0	0	0	0
	Stage 3	5	8	5	7	3	6

Discussion

Not only is it necessary to explain the failure of Smedslund's cognitive conflict training technique for conservation, but it is also necesary to explain why training in general for conservation appears unsuccessful.

To begin with perhaps an explanation of the criteria for demonstration of the effectiveness of training of conservation of substance is appropriate. In order for training in conservation to be effective according to Piaget (1964), two criteria, have to be satisfied. These are generalizability and durability. In other words the concept which was induced not only had to transfer to other situations, but the concept should not extinguish over time. Clearly post-testing for violations of the concept of conservation over a period of 6 months satisfied the foremention criteria. It should be pointed out that because training may not have an immediate effect, it was necessary to continue the remaining two sessions even though no significant difference showed up on the first test. Whereas the criteris in these experiments satisfied Piaget's criteria this was not the case in any of the other training studies. In Beilen's training study, the generalizability criterion for testing whether the concept was induced was extremely limited and durability criteria was not satisfied at all. Similarly in Smedslund's and Bruner's experiments the durability criterion was not met, whereas the generalizability criteria was limited. In Sigel's technique although the generalizability factor was met, the durability factor was not. Because these investigators employed different criteria, it is conceivable that the success in training that Beilen, Bruner, Sigel and Smedslund report relates not to the concept of conservation of substance as Piaget sees it, but rather to some other concept or some deformation of the concept of conservation. In support of the forementioned explanation of the consequences of not employing similar criteria, Gruen (1966) demonstrated that the different criteria and the different procedures employed by Bruner and Smedslund led to a different classification of conserving responses.

If researchers are to make some definite statements about the "Piagetian" concept of conservation, then they are obligated to employ Piagetian criteria for evidence of the concept: Accordingly, one interpretation of the data suggests that the apparent success with training as reported by these forementioned investigators was with a concept other than conservation. It seems apparent that the Piagetian concept of conservation of substance, which in part is a consequence of the "clinical method", is deformed by utilizing different methods (standardized, as opposed to clinical). These methods in part dictate the criteria one employs to ascertain presence or absence of the concept. A further elaboration of this position is presented elsewhere (Mermelstein 1967). Obviously then, different approaches other than the clinical method and different criteria for testing presence of the concept of conser-

vation of substance provide possible explanations for the lack of success of training by any of the training techniques.

It was mentioned earlier that the training methodology employed by Beilen, Bruner and Sigel are generally inconsistent with the Piagetian position and that this also might explain the results. This point shall be elaborated on shortly. Prior to this a further explanation is necessary to account for Smedslund's results. Although it is true that the cognitive conflict position is consistent with Piagetian theory, there is one difference which may provide an explanation of the Smedslund training results. As Smedslund himself reported in an unpublished paper, he now suggests that the organism-object conflict which he espoused is not of sufficient moment to cause a modification of the intelledtual structures. He further suggests that the organism-object relation is too neutral for the child and does not or cannot create the conflict in the child. As an alternative he argues for an organism-organism conflict. In other words a confrontation of different points of view among children as a necessary condition for modification of intellectual structures. Clearly, such a shift in position by Smedslund now makes his position identical to Piaget's rather than similar to Piaget as mentioned earlier. Further Smedslund's argument (1966) for increased concentration on idiographic data rather than nomothetic data represents a potential shift in methodology from the standardized approach to one more in the direction of the clinical approach. Therefore, Smedslund himself now believes that both his cognitive conflict model and his approach need to be shifted in a direction more in line with the Piagetian position.

If Smedslund's argument is correct and if his position was most congruent with Piaget's then most certainly the other positions require a significant shift both in methodology and criteria to attain results similar to those of Piaget.

Piaget's position on the syncretic nature of child's thought with its behavioral manifestation of juxtaposition suggests another possible explanation of the ineffectiveness of the training. If the child's thought manifests itself by linguistic confusion such as juxtaposition then, the language dimension of the training procedure may provide an obstacle rather than facilitate acquisition of the concept. Clearly, because of the apparent ineffectiveness of the training techniques, it is likely that the language employed in the various training techniques did not facilitate acquisition of the Piagetian concept of conservation of substance. Not only is there no indication that the language provided any facilitation but the language may have hindered acquisition of this concept. More specifically the Sigel training technique (Table 1, first post-test), which required more language than the other training technique, appeared to be the least effective method for attaining the concept of conservation.

Perhaps two examples will highlight the possible interference of language in concept acquisition. A child in the first post-test on the non-verbal discrete item claimed emphatically that the marbles in both containers were the same, even though one container had thirty marbles while the other container had ten marbles (a non-conserving response). On the second post-test this child returned to the "perceptually" more appropriate response of claiming that the marbles in both containers were not the same number (a non-conserving response). In a second example, there were several instances when children were confronted with two rows of eight chips. At first they acknowledged their equality but when they began to count numbers of chips they lost sight of their equality and they then maintained that the rows were not equal. Consequently, it appears that the language aspect of the training may not only be inappropriately applied (example 1) but that also the mere act of verbalizing may interfere with concept acquisition (example 2). Accordingly, such evidence is contrary to the position that language facilitates concept acquisition.

Because of the apparent lack of the effectiveness of various kinds of specific training, it becomes necessary to make explicit how specific training differs from cumulative life experiences which Piaget suggests are in part the determining factors for acquisition of the concept of conservation of substance.

Besides the obvious differences of time between cumulative life experiences and specific training, the ordering of experiences must be considered a relevant distinction. Clearly, the nature of <u>any</u> specific training involves a <u>deliberate</u>, ordering of experiences. In other words, the sequence of presentation is paramount. The assumption here is that the child will assimilate the relevant aspects (order, etc.) of these experiences and consequently acquire the concept. But this assumption is not tenable with a Piagetian framework. For if the child constructs his reality, then it does <u>not</u> nescesarily follow that he will assimilate the material in the <u>order</u> presented to him. Accordingly, it is conceivable that the child will assimilate the material in a different order and will utilize the language differently from the way it is presented, (namely inappropriately). In addition, the child may only assimilate part of the material. To illustrate, for the infant, a pillow is not cognized as an object to sleep on but rather an object to be sucked. Smedslund (1966) supports such an analogy when he suggests that the only thing training may do is to support notion that the equality of sets of chips is established. Here children can cognize the specific rows as equal but not that the <u>number</u> is the same. By contrast the cumulative life experiences do not order the events for the child, because the child assimilates those events which fit into his constructinn of reality. If for example, however, a child is in the transitional stage of conservation of substance, it may be that his assimilation of events then corresponds or at least more nearly approaches the ordered presentation of the training.

Although the results lend credence to the limited utility of training and to the possible interference of language, it is clear, particularly from Table 3, that more research is needed to account for the reversals from one post-test to the next. For example, it was interesting to note several instances in which children who gave stage III responses coupled with an appropriate logical explanation on the first post-test reverted back to stage I response on the second or third post-test. Similarly, some children manifested surprise on the first post-test but did not on the second post-test. But, many children manifested surprise on more than one post-test and consequently the contention that the child learned the surprise is a tenuous one. Such reversals, in particular on the verbal discrete may indicate that "logical" explanation too should join the category of "symptom response" that Smedslund describes. In addition, such evidence lends support for an intensive examination of child's mental structure. Such intensive examination is achieved by the clinical method.

Although this interpretation of the reversals may be accurate, it must be viewed with caution until certain questions are answered.

The reversals need to be accounted for either by some theoretical explanation or the possible methodological difficulties described next need to be answered. To begin with these reversals may be indicative of inherent unreliability of not only the Piagetian items, but also of the Mermelstein non-verbal items. Hence the need for the construction of a reliable conservation test. Secondly, the reversals may be in part a function of experimenter bias over the three post-tests. Experiments controlling this factor are needed. Thirdly, these reversals may indicate that the concept of conservation is a transitory phenomenon within a given age range; here today, gone tomorrow. The importance of longitudal studies in this instance is obvious. Fourth, the reversals may be a function of the transitional stage, stage II. Accordingly, there is a need for a more careful examination of this period. Clearly then, not only does the choice of criteria, as Gruen (1966) and we maintain, influence the absence or presence of the "Piagetian" concept of conservation, but the items which constitute the criteria may influence the absence or presence of the concept. Thus, the problem as Gruen (1966) describes may be fundamentally a theoretical and methodological one.

Conclusions:

It is concluded that the "Piagetian" concept of conservation of substance, as measured by the specific criteria described, was not induced by a variety of training techniques. Further it is suggested that language interferes with rather than facilitates acquisition of the concept of conservation of substance. Finally, it is concluded that the problems of reversals merits further exploration.

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Appendix A

Scores of All Subjects on the Three Tasks
Over the Three Post-Tests.

V = Verbal Discrete
NVD = Non-Verbal Discrete
NVC = Non-Verbal Continuous

\- = Stage 1
o = Stage 2
\+ = Stage 3

Subjects		Post-test I	Post-test II	Post-test III
1.	V	-	o	-
	NVD	+	+	+
	NVC	+	+	+
2.	V	-	-	-
	NVD	+	+	-
	NVC	+	+	+
3.	V	+	+	+
	NVD	+	+	+
	NVC	+	+	+
4.	V	+	+	o
	NVD	+	+	+
	NVC	-	+	+
5.	V	-	+	+
	NVD	+	+	+
	NVC	+	+	+
6.	V	o	o	+
	NVD	+	+	+
	NVC	+	-	-
7.	V	-	+	+
	NVD	+	+	-
	NVC	+	+	+
8.	V	-	-	o
	NVD	+	+	+
	NVC	+	+	+
9.	V	+	o	+
	NVD	+	+	+
	NVC	-	+	+
10.	V	+	o	
	NVD	+	+	
	NVC	-	-	

Subjects		Post-test I	Post-test II	Post-test III
11.	V	+	+	+
	NVD	+	+	+
	NVC	-	-	+
12.	V	+		+
	NVD	+		-
	NVC	-		-
13.	V	o		
	NVD	+		
	NVC	+		
14.	V	+		+
	NVD	+		+
	NVC	-		+
15.	V	+	-	-
	NVD	+	-	+
	NVC	-	+	-
16.	V	+	+	+
	NVD	+	+	+
	NVC	-	-	+
17.	V	+	-	-
	NVD	+	-	-
	NVC	+	+	-
18.	V	o	-	
	NVD	+	+	
	NVC	+	-	
19.	V	+	o	-
	NVD	+	+	+
	NVC	-	+	+
20.	V	+	o	o
	NVD	+	+	+
	NVC	-	+	+
21.	V	+	-	-
	NVD	+	+	+
	NVC	-	-	-
22.	V	o	o	+
	NVD	+	+	+
	NVC	+	+	+
23.	V	-		
	NVD	+		
	NVC	+		

Subjects		Post-test I	Post-test II	Post-test III
24.	V	-	o	-
	NVD	+	+	+
	NVC	+	+	+
25.	V	+	-	+
	NVD	+	+	+
	NVC	-	+	+
26.	V	+	o	
	NVD	+	-	
	NVC	-	-	
27.	V	+	+	+
	NVD	+	+	+
	NVC	-	-	-
28.	V	+	o	o
	NVD	+	+	+
	NVC	-	+	+
29.	V	+	o	
	NVD	+	+	
	NVC	+	+	
30.	V	+	+	+
	NVD	+	+	-
	NVC	+	-	-
31.	V	+	o	
	NVD	-	+	
	NVC	-	-	
32.	V	+	+	-
	NVD	-	-	-
	NVC	-	-	-
33.	V	+	o	-
	NVD	-	-	-
	NVC	-	+	-
34.	V	-	-	
	NVD	-	-	
	NVC	-	-	
35.	V	-	-	
	NVD	-	-	
	NVC	-	-	
36.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-

Subjects		Post-test I	Post-test II	Post-test III
37.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-
38.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-
39.	V	-	-	-
	NVD	+	-	-
	NVC	-	-	-
40.	V	-	-	+
	NVD	+	+	+
	NVC	-	-	-
41.	V	-	-	-
	NVD	+	-	-
	NVC	-	-	-
42.	V	o	o	-
	NVD	+	-	-
	NVC	-	-	-
43.	V	-	o	-
	NVD	-	-	+
	NVC	-	-	-
44.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-
45.	V	-	+	-
	NVD	-	-	-
	NVC	-	-	-
46.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-
47.	V	o	-	
	NVD	-	-	
	NVC	+	-	
48.	V	-	-	-
	NVD	-	-	-
	NVC	+	+	+
49.	V	+	+	-
	NVD	-	-	-
	NVC	-	-	-

Subjects		Post-test I	Post-test II	Post-test III
50.	V	-	-	
	NVD	+	+	
	NVC	-	+	
51.	V	-	-	
	NVD	+	+	
	NVC	-	+	
52.	V	o	-	
	NVD	+	+	
	NVC	-	-	
53.	V	-	o	
	NVD	+	+	
	NVC	-	-	
54.	V	+	-	+
	NVD	-	-	-
	NVC	-	-	-
55.	V	+	o	+
	NVD	-	+	+
	NVC	-	-	-
56.	V	+	o	o
	NVD	-	-	-
	NVC	-	-	-
57.	V	-	-	-
	NVD	+	-	+
	NVC	-	-	-
58.	V	-	-	+
	NVD	+	+	-
	NVC	-	-	-
59.	V	-	-	-
	NVD	-	-	-
	NVC	+	+	+
60.	V	o	o	o
	NVD	-	+	+
	NVC	+	-	-
61.	V	-	o	-
	NVD	-	-	-
	NVC	-	+	-
62.	V	-	+	-
	NVD	-	+	-
	NVC	-	-	-

Subjects		Post-test I	Post-test II	Post-test III
63.	V	o	-	+
	NVD	-	+	-
	NVC	-	-	+
64.	V	-	o	o
	NVD	-	+	+
	NVC	+	+	+
65.	V	-	-	
	NVD	-	-	
	NVC	+	+	
66.	V	-	-	
	NVD	-	-	
	NVC	-	-	
67.	V	-	-	-
	NVD	-	+	-
	NVC	-	-	-
68.	V	-	o	o
	NVD	-	+	+
	NVC	-	-	+
69.	V	-	-	-
	NVD	-	+	-
	NVC	-	+	-
70.	V	-	o	
	NVD	-	-	
	NVC	-	-	
71.	V	o		-
	NVD	-		-
	NVC	-		-
72.	V	-	-	
	NVD	-	-	
	NVC	-	-	
73.	V	o	o	-
	NVD	-	-	-
	NVC	-	-	-
74.	V	-	-	
	NVD	-	-	
	NVC	-	-	
75.	V	o	+	+
	NVD	-	+	+
	NVC	-	+	+

Subjects		Post-test I	Post-test II	Post-test III
76.	V	-	-	+
	NVD	-	-	-
	NVC	-	-	-
77.	V	o	o	o
	NVD	+	+	+
	NVC	-	-	+
78.	V	o	+	+
	NVD	+	+	
	NVC	-	-	+
79.	V	o	-	-
	NVD	+	+	-
	NVC	-	-	-
80.	V	+	+	
	NVD	-	+	
	NVC	-	+	
81.	V	+		+
	NVD	-		+
	NVC	-		+
	V	-	+	-
82.	NVD	+	+	+
	NVC	-	+	-
83.	V	-	o	-
	NVD	-	-	-
	NVC	-	-	-
84.	V	o	o	-
	NVD	-	-	-
	NVC	-	-	-
85.	V	-	o	-
	NVD	-	-	-
	NVC	-	-	-
86.	V	-	o	-
	NVD	-	-	-
	NVC	-	-	-
87.	V	o	o	-
	NVD	-	-	-
	NVC	-	-	-
88.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-

Subjects		Post-test I	Post-test II	Post-test III
89.	V	o	+	+
	NVD	-	-	+
	NVC	-	-	-
90.	V	+	o	+
	NVD	-	-	+
	NVC	-	-	-
91.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-
92.	V	o	-	
	NVD	-	+	
	NVC	-	+	
93.	V	-	-	
	NVD	+	-	
	NVC	-	-	
94.	V	-	-	+
	NVD	-	-	-
	NVC	-	-	-
95.	V	-	o	-
	NVD	-	-	-
	NVC	-	-	-
96.	V	-	o	+
	NVD	+	-	+
	NVC	-	-	-
97.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-
98.	V	o	o	-
	NVD	-	-	-
	NVC	-	-	-
99.	V	+	-	-
	NVD	-	+	+
	NVC	-	+	+
100.	V	-	o	
	NVD	-	-	
	NVC	-	-	
101.	V	-	o	+
	NVD	+	-	-
	NVC	-	-	-

Subjects		Post-test I	Post-test II	Post-test III
102.	V	o	+	+
	NVD	+	-	
	NVC	-	-	
103.	V	-	o	
	NVD	-	+	
	NVC	o	-	
104.	V	-	-	+
	NVD	-	-	+
	NVC	-	-	+
105.	V	-	-	-
	NVD	+	+	+
	NVC	-	+	-
106.	V	-	-	
	NVD	-	-	
	NVC	-	-	
107.	V	-	+	
	NVD	-	+	
	NVC	-	-	
108.	V	-	o	+
	NVD	-	+	+
	NVC	-	+	+
109.	V	o	-	o
	NVD	-	+	+
	NVC	-	+	+
110.	V	o	+	+
	NVD	-	+	+
	NVC	-	+	+
111.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-
112.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-
113.	V	o	+	+
	NVD	-	-	-
	NVC	-	-	-
114.	V	-	-	-
	NVD	-	+	+
	NVC	-	-	-

Subjects		Post-test I	Post-test II	Post-test III
115.	V	-	-	-
	NVD	-	-	-
	NVC	-	-	-